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MALAYAN SOILS (ii) SOME PADI SOILS.

By M. Barrowcliff.

The analyses given in this paper have been made in recent months and are, for the most part, of soils collected in Kedah by the Director of Agriculture and Mr. W. G. Maxwell, British Adviser. The others represent three samples of fertile Siam soils brought from that country by Mr. E. Bateson and several collected near Kuala Kangsar at the instigation of the District Officer, Mr. Ellerton.

The method of analysis adopted, which the writer omitted to mention in a previous paper dealing with soil analysis (*Agr. Bull. F.M.S.* No. 6 p. 210) is that adopted by the British Agricultural Education Section, by which the soil is extracted for 3 days with hot hydrochloric acid of specific gravity 1.115, and the various constituents determined in the solution thus obtained. The "available" potash and phosphoric acid are estimated in the solution prepared by digesting the soil for 7 days with cold 1% citric acid, according to the method of Dyer.

The subjoined table is of the figures obtained for the more important essential plant foods, after which are given some notes on the individual soils, followed by an attempt to discuss the manurial requirements of Malayan padi soils in general. The full analytical data, etc. will be found at the end.

Soil		Potash K_2O	Phosphate P_2O_5	"Available" Potash	"Available" Phosphate	Nitrogen	Approx. Yield gantangs per acre	Ratio $\frac{K_2O}{P_2O_5}$
Kedah	1	0.368	0.048	0.0046	0.0062	0.280	400	7.6
,,	2	0.55	0.060	0.0388	0.0084	0.386	900	9.1
,,	3	0.177	0.0185	—	—	0.205	very poor	9.5
,,	4	0 555	0.041	—	—	0.246	130-260	13.5
,,	5	0.174	0.040	0.0034	0.0053	0.286	1100	4.3
,,	6	0.43	0.048	—	—	0.356	"medium"	9.0
,,	7	0.138	0.024	—	—	0.140	"poor"	5.7
,,	8	0.49	0.047	—	—	0.614	"fair"	10.4
,,	9	0.143	0 021	0.0282	0.0174	0.750	"excellent"	6.9
,,	10	0.52	0.072	0.0087	0 0093	0.353	,,	7.2
,,	11	0.51	0.050	—	—	0.670	,,	10.0
Siam	1	0.49	0.133	0.0155	0.0111	0 200	600	3.6
,,	2	0.448	0.054	0.0075	0.005	0.398	600-700	8.3
,,	3	0.63	0.111	0.0187	0.0104	0.269	*	5.6
K. Kangsar	1	0.24	0.045	0.0054	0.0038	0.123	600	5.3
,,	2	0.0245	0.0146	—	—	0.170	very poor	1.7
,,	3	0.28	0.068	0.0083	0.0025	0 110	300-400	4.1

*This yield cannot be stated, the crop being habitually damaged by rats.

Kedah 1 is described as a rich soil that cannot be ploughed. Although richer in plant food than the Kuala Kangsar 1 soil the yield is less. This must be attributed to the lack of aeration between the padi seasons and would be remedied if by better drainage cultivation was rendered possible.

Kedah 2, giving an excellent yield, contains high proportions of phosphate and potash, and is of lighter texture than 1, as shewn by the mechanical analysis. No. 3, of which the return is very poor, is seen to contain little clay and phosphate. At the same time if the soil as represented by the sample is fairly deep, i.e. is not underlain by sand at a shallow depth, and can be adequately irrigated and drained it would be expected to respond moderately well to cultivation and to phosphatic manure such as the guano in use in Kedah.

No. 4 contains high proportions of fine silt and clay and is probably difficult to work. Its store of potash and phosphate is good, and like soil 1 it probably suffers from lack of cultivation.

The extremely high yield of No. 5 is hardly warranted by the analytical figures and can only be attributed to the "heavy manuring" with guano that it receives. Adjacent land, unmanured, is said to yield poorly. This instance affords striking support to the opinion to be subsequently advanced regarding the importance of phosphatic manures.

No. 6 is described as medium upland and is seen to be also well supplied with plant food. It is a soil from which, with adequate irrigation, drainage and cultivation, good yields would be expected.

No. 7, poor upland, is too sandy and deficient in clay to be of much value as a padi soil, and resembles No. 2 from Kuala Kangsar in this respect, though not so bad.

It is possible that some of these sandier upland soils could be laid down to fodder plants and profitably utilised for pasture. In this case some phosphatic manuring would be beneficial.

No. 8 is a very heavy soil well supplied with plant nutrients and rich in organic matter. Given cultivation, sufficient water and drainage it should yield a good average crop. 9, 10, and 11 are described as "new" lands and to give excellent yields. In No. 9 an unusually large proportion of the phosphate is in the "available" condition, in all probability derived from humifying vegetable matter near the surface. 10 and 11 are extremely well supplied with phosphate and are in this respect amongst the best of the Kedah soils. The amounts of nitrogen and organic matter are also large.

Of the Kuala Kangsar soils, No. 2 being chiefly sand contains practically no plant food and need not be further considered.

No. 1 gives an excellent yield, superior to No. 3 and to several of the Kedah soils which are apparently rather better supplied with the essential plant nutrients. This must be attributed to its texture, which is very similar to that of the No. 1 Siam soil—a soil, Mr. Bateson learnt, that is extremely highly prized and realises the maximum rental. The Kuala Kangsar land softens rapidly on the addition of the irrigation water, and, between the padi seasons, must get thoroughly aerated. The percentage of nitrogen, it is interesting to note, is almost the least of all the soils examined.

No. 3, on which are being carried out the Economic Botanist's experiments (*Agr. Bulletin, F. M. S.*, No. 9 p. 319), although better supplied with phosphate has less of this in the "available" form. This land is hard and remains so on irrigating, and it is almost undoubtedly due to its impervious texture that the yield is not a high one, as there can be little weathering when the water is off the land and consequently only small amounts of "available" nutrient accumulated for the use of the next crop. It is therefore not surprising to see that Mr. Barritt obtained largely increased yields by cultivation alone.

The Siam soils are all richly endowed with all the essentials, and in respect of phosphate contain considerably more than the Malayan ones. If very high yields are not obtained there must be outside contributory causes, such as too much, too little, or unsuitable—water, or to damage by pests.

Before discussing the question of the manuring of padi the results of some analyses made for the purpose of estimating the quantities of the various plant foods removed by the crop may be given.

They represent the average composition of several rice plants received from the Economic Botanist, and the results are calculated on the assumption of a yield of 400 gantangs of padi per acre.

The dried plants were composed of straw 55.0%, husk 12.5%, and grain 32.5%, containing

	Nitrogen	Potash	Phosphate
Straw ...	0.70%	1.92%	0.078%
Husk ...	0.79	0.594	0.268
Grain ...	1.70	0.298	0.414

400 gantangs of padi represent :—

1,450 lbs. husked rice containing 24.65 lbs. N, 4.32 lbs. K_2O, 6.00 lbs. P_2O_5

593 ,, husks ,, 4.68 ,, ,, 3 52 ,, ,, 1.59 lbs. P_2O_5

2,497 ,, straw ,, 17.48 ,, ,, 47.94 ,, ,, 1.94 lbs. P_2O_5

so that the total plant food removed per acre is 46.81 lbs. nitrogen, 55.78 lbs. potash, and 9.53 lbs. phosphate.

In Java the practice exists amongst the native cultivators of burning the straw and husks and returning ashes to the sawahs. By doing so no less than 51.46 lbs. of potash (90%) and 3.53 lbs. of phosphate (37% of the total removed) are put back.

This practice therefore is a sound one, it involves little trouble, and its employment should be encouraged.

When this is done there is still left an unavoidable loss of 46.81 lbs. nitrogen, 4.32 lbs. potash, and 6.00 lbs. phosphate per acre per 400 gantangs of padi removed.

With nitrogen all these soils are seen to be well supplied, when it is remembered that each 0.1% in the surface 6 inches represents over 2,000 pounds per acre, sufficient for 40 crops. Moreover considerable quantities of this element, in the form of nitrate and am-

monia, are brought on to the field by the irrigation water, as has been demonstrated by der Berger in Java. Further quantities are accumulated between the padi seasons by the weeds which spring up and which are subsequently ploughed or changkolled under. There seems therefore to be little need to apprehend deterioration of these lands through lack of this important element. At the same time large though the amount of nitrogen present may be it needs to be made available for the use of the plant, which it can only be if the soil by cultivation and drainage is adequately aerated. The growing of a leguminous second crop, a practice not as yet employed in this country, must also be of value in improving the soil. On the other hand as pointed out by Dr. Simon in a paper recently reviewed in the *Agr. Bulletin* (No. 9 p. 338) when the padi field remains under stagnant water for any length of time deterioration sets in.

When considering the manurial requirements of a soil what is known as the Law of Minimum should be well borne in mind. This states that the yield of any crop depends upon the available supply of that essential element of plant food that is present in least amount, or, in other words, that no super-abundance of plant food generally can compensate for a deficiency in any one essential element. We have seen that in all probability under normal conditions there should be no deficiency in nitrogen ; the elements potash and phosphate remain to be considered.

Padi soils are invariably clay soils or contain a considerable proportion of clay, and all clays are rich in potash. The high percentages actually present in these soils are seen in the table. Just as in the case of nitrogen the potash too needs to be made " available" to the plant, a change also assisted by the weathering which takes place when air has free access to the soil.

It will be noticed that although the total reserve of potash present is so much greater than that of phosphate yet the " available " quantity is little more. This is due to the well known fact that whereas soluble potash salts are easily leached out of the soil, phosphates are retained much more tenaciously. (For this reason much more potash than phosphate is brought on to the land by the irrigation water). Not the least of the advantages of growing a second or cover crop on the land is that it assimilates the potash as it becomes available and prevents it being leached out, subsequently, after being ploughed under, yielding it up again for absorption by the roots of the rice plant.

It is of course largely immaterial whether a crop of beans or earthnuts are raised and the foliage turned under or whether the land is laid down to forage crops and grasses and grazed by cattle, the ultimate result being much the same.

As evidence of the sufficiency of potash the Kuala Kangsar No. 1 soil may be cited again. This contains an amount which is amongst the smallest found and yet yields excellently, a circumstance also explicable by its open texture and the "weathering" it consequently gets.

Potash therefore cannot be considered deficient in the sense defined in the Law of Minimum, leaving only phosphate to be discussed.

Of the three essential elements this one is present in by far the least amount, the ratio of potash to phosphate varying as is seen from the table from 13·5 to 3·6, excluding the infertile Kuala Kangsar No. 2 soil. Furthermore phosphatic compounds in soils are in all probability less easily decomposed by weathering, etc., than the potassic ones, i.e. phosphate becomes available to the plant at a slower rate although it is more permanent and less easily leached out. This is illustrated by the established fact that the maximum effect of basic slag and others of the insoluble phosphate fertilisers is often only attained in the second and even the third season after application.

The conclusion is arrived at therefore that it is in phosphoric acid that the soil of only average fertility is most likely to be deficient and that if it is possible to find a fertiliser sufficiently cheap and beneficial to be commercially applicable to padi lands in Malaya it will prove to be one that has phosphate as its dominant if not its only constituent.

Ample support for this view is found in the instance of the Kedah No. 5 soil which is heavily manured with Perlis guano and which, as previously pointed out, gives the exceptionally high yield of 1,100 gantangs per acre, adjacent land yielding poorly.

The native cultivators in the Rembau district of Negri Sembilan use a phosphatic manure—bones—also.

Actual experience in Java where the soils are poorer in nitrogen than in Malaya is to the same effect, and in some districts the Government agricultural instructors act as distributors of superphosphate to the natives.

Referring again to the analyses it is seen that the poor yielding soils all contain little phosphate whilst amongst the better ones a fairly close relationship exists between the yield and the "available" phosphate. This correlation, in the writer's opinion, would have been still closer had a solvent less energetic than even 1% citric acid been used; neutral ammonium citrate for instance.

The Department is arranging experiments on the manuring of padi in different districts of Negri Sembilan and Pahang, when the relative effect of the various phosphatic fertilisers on the yields will be tried. It will be necessary to continue the observations over

several seasons in order to determine the total effect of the less soluble (and less expensive) compounds.

Another experiment, to be tried on the hard and impervious Kuala Kangsar No. 3 soil, is that of subsoiling by means of dynamite, a measure of soil amelioration being now largely made use of in America and other countries. The operation is not prohibitively expensive and the effect is said to persist over several seasons.

Kedah Soils.

No. 1.

Mechanical Analysis.		*Chemical Analysis.*	
Fine Sand	2·1%	Moisture	4·7%
Silt	22·8	Loss on Ignition	11·0
Fine Silt	40·7	Potash	0·368
Clay & Humus	34·4	Phosphate	0·048
		Lime	0·33
"Available" Potash	·0046%	Magnesia	0·56
,, Phosphate	·0062%	Nitrogen	0·280

From 5th mile Sungei Koroh Road. A rich soil that cannot be ploughed. Yield about 380 gantangs per acre.

No. 2.

Mechanical Analysis.		*Chemical Analysis.*	
Fine Sand	10·0%	Moisture	4·7%
Silt	27·2	Loss on Ignition	12·10
Fine Silt	31·7	Potash	0·55
Clay & Humus	31·1	Phosphate	0·06
		Lime	0·19
"Available" Potash	·0388%	Magnesia	0·52
,, Phosphate	·0084%	Nitrogen	0·386

Kuala Kangkong. Haji Lima.
Yield in a good year about 900 gantangs per acre.

No. 3.

Mechanical Analysis.		*Chemical Analysis.*	
Fine Sand	41·0%	Moisture	1·07%
Silt	20·9	Loss on Ignition	6·1
Fine Silt	25·6	Potash	0·177
Clay & Humus	12·5	Phosphate	0·0185
		Lime	0·08
		Magnesia	0·073
		Nitrogen	0·205

Off the earth road leading from the Langar Road. Extremely poor soil, practically no yield.

No. 4. *Mechanical Analysis.*

Fine Sand	3·2%
Silt	10·5
Fine Silt	58·1
Clay & Humus	28·2

Chemical Analysis.

Moisture	2·3%
Loss on Ignition	8·1
Potash	0·555
Phosphate	0·041
Lime	0·117
Magnesia	0·176
Nitrogen	0·246

At the end of the present Langar Road.

Rather a poor soil, requires manuring. Yield 130-260 gantangs per acre according to the amount of manure (guano) supplied.

No. 5. *Mechanical Analysis.*

Fine Sand	14·2%
Silt	34·1
Fine Silt	36·9
Clay & Humus	14.8

Chemical Analysis.

Moisture	2·25%
Loss on Ignition	6·65
Potash	0·174
Phosphate	0·040
Lime	0·055
Magnesia	0·043
Nitrogen	0·286

"Available" Potash ·0034%

„ Phosphate ·0053%

Tungku Hedong's land behind the gaol, Alor Star. Ploughed and probably highly manured. Yield 1100 gantangs per acre. Adjacent land, untreated, appeared to be yielding poorly.

No. 6. *Mechanical Analysis.*

Fine Sand	6·4%
Silt	17·8
Fine Silt	33·0
Clay & Humus	42·8

Chemical Analysis.

Moisture	5·4%
Loss on Ignition	15·6
Potash	0·43
Phosphate	0·048
Lime	0·96
Magnesia	0·41
Nitrogen	0·356

From the 24½ mile Perlis Road. Medium upland.

About the limit of padi cultivation.

No. 7. *Mechanical Analysis.*

Fine Sand	43·6%
Silt	24·2
Fine Silt	22·9
Clay & Humus	9·3

Chemical Analysis.

Moisture	0·65%
Loss on Ignition	3·1
Potash	0·138
Phosphate	0·024
Lime	0·076
Magnesia	0·15
Nitrogen	0·14

From the 24½ mile Perlis Road.

Poor upland.

No. 8. *Mechanical Analysis.*

Fine Sand	7·6%
Silt	13·7
Fine Silt	26·2
Clay & Humus	52·5

Chemical Analysis.

Moisture	4·3%
Loss on Ignition	21·2
Potash	0·49
Phosphate	0·047
Lime	0·075
Magnesia	0·133
Nitrogen	0·614

From the 13th mile Perlis Road.
Fair upland.

No. 9. *Mechanical Analysis.*

Fine Sand	10·6%
Silt	26·9
Fine Silt	35·0
Clay & Humus	27·5
"Available" Potash	·0282%
,, Phosphate	·0174%

Chemical Analysis.

Moisture	6·0%
Loss on Ignition	21·6
Potash	0·143
Phosphate	0·021
Lime	0·095
Magnesia	0·226
Nitrogen	0·75

Tanah Dairah. Bendang Kuar.

This and the two following soils were taken near Kuala Kuar, and are reported to be "new" soils and to yield excellent crops.

No. 10. *Mechanical Analysis.*

Fine Sand	5·9%
Silt	25·0
Fine Silt	40·7
Clay & Humus	28·4
"Available" Potash	·0087%
,, Phosphate	·0093%

Chemical Analysis.

Moisture	5·1%
Loss on Ignition	14·2
Potash	0·52
Phosphate	0·072
Lime	0·12
Magnesia	0·17
Nitrogen	0·353

Tanah Dairah. Padang Hung.

No. 11. *Mechanical Analysis.*

Fine Sand	5·3%
Silt	23·1
Fine Silt	39·1
Clay & Humus	32·5

Chemical Analysis.

Moisture	6·3%
Loss on Ignition	18·1
Potash	0·51
Phosphate	0·050
Lime	0·064
Magnesia	0·194
Nitrogen	0·67

Kubang Java.

Siam Soils.

No. 1. *Mechanical Analysis.*		*Chemical Analysis.*	
Fine Sand	29·8%	Moisture	3·0%
Silt	22·9	Loss on Ignition	6·4
Fine Silt	29·9	Potash	0·49
Clay & Humus	17·4	Phosphate	0·133
		Lime	0·41
"Available" Potash	·0155%	Magnesia	0·415
,, Phosphate	·0111%	Nitrogen	0·20

From Ayuthia. Yield 600 gantangs per acre.

No. 2. *Mechanical Analysis.*		*Chemical Analysis.*	
Fine Sand	3·5%	Moisture	6·7%
Silt	12·7	Loss on Ignition	12·8
Fine Silt	39·8	Potash	0.448
Clay & Humus	44·0	Phosphate	0·054
		Lime	0·14
"Available" Potash	·00746%	Magnesia	0·113
,, Phosphate	·0050%	Nitrogen	0·398

From Klong Kansit. Canal No. 5.
Yield 600-700 gantangs per acre.

No. 3. *Mechanical Analysis.*		*Chemical Analysis.*	
Fine Sand	8·0%	Moisture	6·6%
Silt	16·7	Loss on Ignition	9·0
Fine Silt	36·1	Potash	0·63
Clay	39·2	Phosphate	0·111
		Lime	0·36
"Available" Potash	·0187%	Magnesia	0·45
,, Phosphate	·0104%	Nitrogen	0·269

From Klong Prai Wet.
Yield cannot be fairly stated, this district suffering from depredations by rats.

Soils from near Kuala Kangsar.

No. 1. *Mechanical Analysis.*		*Chemical Analysis.*	
Fine Sand	40·0%	Moisture	2·1%
Silt	14·0	Loss on Ignition	8·2
Fine Silt	27·4	Potash	0·241
Clay & Humus	18·6	Phosphate	0·045
		Lime	0·15
"Available" Potash	·0054%	Magnesia	0·24
,, Phosphate	·0038%	Nitrogen	0·123

"Tanah Merah." Yield 600 gantangs per acre.

No. 2.

Mechanical Analysis.		*Chemical Analysis.*	
Fine Sand	68·9%	Moisture	0·98%
Silt	14·0	Loss on Ignition	5·7
Fine Silt	10·2	Potash	0·0245
Clay & Humus	6·9	Phosphate	0·0146
		Lime	0·07
		Magnesia	0·15
		Nitrogen	0·17

Yield very poor.

No. 3.

Mechanical Analysis.		*Chemical Analysis.*	
Fine Sand	23·6%	Moisture	2·86%
Silt	32·5	Loss on Ignition	11·1
Fine Silt	26·9	Potash	0·28
Clay & Humus	17·0	Phosphate	0·068
		Lime	0·30
"Available" Potash	·0083%	Magnesia	0·52
„ Phosphate	·0025%	Nitrogen	0·11

From the plot used by the Department for experimental purposes. Average yield 300-400 gantangs per acre.

GENERAL NOTES CONCERNING LOCUSTS.

By H. C. Pratt.

The somewhat sudden appearance in large numbers of a species of locust (*Pachytylus danicus*) in this country may render these notes on locusts of interest to planters and residents. I propose to give a brief resumé of their habits from the laying of the eggs to the adult insect with a few general remarks appended.

The eggs of locusts are laid in the ground on small hills or hillsides which are exposed to the heat of the sun. Those places where the grass is fairly short are usually selected and the reasons for this may be that the female can more readily insert the abdomen into the ground in such situations, and the heat of the sun will hasten hatching. Soils of a loose but compact nature are chosen. In the act of oviposition the female inserts the abdomen into the ground almost as far as the point of junction of the wings with the body. The depth thus reached varies from ½ to 4 inches, and in the passage thus formed about 30 to 50 eggs are laid in packed masses. During the operation a male often attends the female.

The length of the egg stage will vary, as will the other stages passed through before the imago appears, but in this country it is unlikely that three weeks is exceeded and about a fortnight will probably prove to be the most general period. Several egg masses may be laid by one female.

The young hoppers then emerge, and being essentially gregarious they congregate in one or several groups. In this stage the young of *P. danicus* present the appearance of a black mass. They are often very still for a few days after emergence unless disturbed, when they will run a short way and then hop an inch or so into the air. They keep together and move but slowly, progressing about 20 to 30 yards a day, their activity increasing somewhat as they grow older. The distance that is covered in the course of 24 hours will depend to some extent on the amount of food in the vicinity, and where there is no lack of this they may be congregated in the same spot for days together. Should they move, the warmer hours of the day are chosen for the march, and this is more or less true of most young grasshoppers.

These very young locusts frequent the roadsides, and the roads, and places where there is little or no shade. It is probable that during heavy rain they huddle together on the sides of road drains or beneath any available shelter, and thus protect themselves.

This form is the larval one, and the length of its duration in this species has yet to be determined. The pupal stage is next reached but what has been said concerning the young will apply very largely to these. They are larger, more active, do not confine themselves to such open spaces, and will naturally consume more food. It is however in the adult flying stage when the locusts travel in swarms and present such a formidable appearance, that they are regarded as more serious than the tiny hoppers which are confined to a space of 50 yards, or those in the pupal stage which may be rather more scattered. Yet it is in the smaller stage before the adult insect appears that immense damage may be caused to wheat, rice, and other crops. I do not mean to convey the idea that the mature insect does no damage. On the contrary they are most destructive.

When the wings are developed the instinctive migratory habit reveals itself, and they commence flying in large numbers to various parts of the country. Their direction, and the distance that they travel, will depend very largely upon the weather conditions, and perhaps upon the amount of food in the locality, but this latter is doubtful. One swarm will often circle round a place for days together, alighting here and there, destroying any crop they may fancy as food. It is noteworthy that when the females are laying they are difficult to disturb.

The rate of progress of swarms will vary. They are probably unable to fly more than 25 miles per day and in this species the migratory instincts do not seem so strongly developed as in many others.

The damage that can be done by locusts is very hard to appreciate unless actually seen. The swarms that have visited us in this country are by no means large but the possibilities of increase and extended range do not provide comfortable reflection.

Locusts have been most destructive in many parts of the world owing to their adaptability, their powers of multiplication, the fact that they are gregarious, and that they are assisted during one of their stages by flight. Under favourable conditions excessive multiplication makes them a serious pest. The work of months may be destroyed just before the harvest is reaped, and this within a few hours. A very fair idea of the nature and rapidity of their work has already been provided in Kuala Lumpur, and this with a comparatively small swarm which was much disturbed in its operations. Locusts, while there is plenty of food and flights are small, are somewhat fastidious in selecting their food, and it is only when they increase in excessive numbers that they become omnivorous. Under such conditions the records of other parts of the world show that large swarms, when food is scarce through their own destructiveness, or other causes, will devour everything that comes in their way, even feeding upon things that kill them. There is by no means any necessity to take the alarmist point of view with regard to the sudden appearance of locusts in this country, but planters and others living in the various parts of the Malay States would render great service to the Department of Agriculture if they would report a breeding ground, or the young hoppers immediately they are noticed.

THE MANUFACTURE OF RUBBER GOODS.

(*Continued*).

By B. J. Eaton.

The previous article contains a description of the main operations connected with the manufacture of vulcanised rubber articles from the raw material.

I now propose to give brief details of the manufacture of a few of the principal rubber articles in common use.

Cut Sheet.

The manufacture of cut sheet is a special industry and the cut sheet consists of raw or unvulcanised rubber. This cut sheet is used as such in cable works, as will be described later, but is also made up into tobacco pouches, thin surgical goods, etc., and vulcanised by the cold process. The manufacture of cut sheet appears to be confined to one or two firms. The writer had the privilege of

seeing the process carried out in a cable factory, in which it constituted the most interesting part of the manufacture or building up of the cable.

The modus operandi is as follows:—The pure washed and dried rubber (it may be stated here, that, probably in every instance only Fine Hard Para is used for making cut sheet) is first masticated for about an hour in a deeply corrugated or fluted roller revolving in an outer casing, so that the rubber passes between the outer casing and the roller. No operator is required as the rubber is carried round automatically. The casing of the machine is water-cooled to prevent excessive heating caused by the friction set up.

The plastic mass of rubber is then placed in cubical or cylindrical iron or steel vessels (the writer saw cylindrical vessels used) and subjected to hydraulic pressure; the pressure remains on the rubber for a week or perhaps longer. The cylinder containing the rubber is subsequently frozen in a refrigerating room for a long period.

The rubber after such treatment becomes very hard and compact and, from the hard cylindrical block of rubber, very thin sheet can be cut on special machines provided with a rapidly oscillating knife.

The width of the sheet will depend on the length of the cylinder of rubber; the length of the sheet depends on the thickness of the sheet which is required and the diameter or circumference of the cylindrical block.

It should be mentioned that the axle or rod on which the cylinder of rubber rotates in the cutting machine is placed through the block before it is frozen or sometimes subsequently, to compress still further the rubber in the cylinder.

The speed of the knife and the thickness of the rubber sheet which is cut, can be varied as required. Sheet $\frac{1}{100}$th to $\frac{1}{200}$th of an inch thickness can be cut from the cylindrical rubber block in this way. During the cutting process cold water is continually run over the knife to assist the cutting action and soap solution used to prevent the thin rubber sheet from sticking together.

Tobacco pouches, balloons, surgical goods, inner cores for cables and other articles are made from cut sheet.

Three methods of vulcanisation may be employed for articles made in this way. (1) Cold curing in dilute sulphur chloride; (2). curing by hot vaporised sulphur chloride; (3) by dipping into sulphur and subsequently steam curing.

Spread sheet prepared on friction calenders has been used to a great extent to replace cut sheet, even the peculiar striated markings produced on cut sheet by the cutting knife being imitated.

Elastic Thread.

The writer had no opportunity of observing the manufacture of this somewhat important article of commerce. The method of manufacture has been described in various text-books and is briefly as follows :—The rubber with added sulphur is worked into a paste with solvent naphtha and spread on cloth, wound on drums between cloth and steam cured ; it is subsequently cut automatically to the necessary size on rollers and treated with caustic soda to remove free sulphur.

Such thread is used for elastic webbings, braces, etc., and in recent years for winding the inner cores of golf balls.

As in the case of cut sheet, only the highest qualities of Fine Hard Para, with a low resin content, are used for the purpose.

It is, I think, quite probable that the highest qualities of smoked plantation para sheet could be substituted.

Rubber pavement, tiles and Flooring.

This branch of the industry merits some attention, owing to the interest displayed during recent years. Although very little rubber pavement has been laid down so far, chiefly on account of the high price of the raw material, the manufacture of rubber tiles, etc., for flooring appears to be making considerable progress, and in some works, large orders are being supplied. Various offices, hotels, private houses, and ships have been supplied with rubber flooring which has been found to be very suitable. The material can be made in various artistic designs by the use of coloured pigments in the compounded rubber, and tiles of various shapes are made and fitted together to make a solid floor. These tiles may be made in moulds or cut from sheets of different colours by means of stamping machines of the desired design.

Rubber mats belong to this class of goods, the holes being punched out by machines or the mat made in special moulds.

Rubber heels and Soles.

The manufacture of circular and other rubber heels for boots has assumed quite an important and extensive character and the writer saw the methods of manufacture in one or two factories visited in Europe. These articles are made in moulds—a number of moulds being cut out on a single iron plate, and the mould and contents placed in open presses.

Very cheap grades of these heels contain practically no raw rubber as such, but consist almost entirely of reclaimed rubber—*i.e.*, waste vulcanised rubber which has undergone certain treatment to remove free sulphur, etc., and a large percentage of mineral matter.

The addition of mineral ingredients tends to harden the compound and give greater resistance to abrasion, apart from reducing the cost.

Rubber soles for boots and shoes are made in a somewhat similar manner. In all such goods, as a rule, there is a close correspondence between the price and the percentage of rubber, since the rubber is the most expensive component. The manufacture of rubber shoes and boots is quite a special process in some respects but I was unfortunately unable to devote any time to the inspection of the processes in one of the largest factories visited.

Surgical Goods.

Various hollow articles which were seen in process of manufacture contain a small quantity of ammonium carbonate inside, which, during vulcanisation in the moulds, evolves ammonia on heating and inflates the rubber casing till it assumes the forms of the moulds in which it is placed. These articles are vulcanised in steam pans or autoclave presses.

Carbon black is the pigment used for the well-known black articles and antimony sulphide (golden antimony) for red goods.

Other articles, as stated before, are made from cut sheet and cold cured.

Air cushions and mattresses, hot water bottles, balls for syringes, etc., are a few well-known articles which may be classed under this heading. Much hand labour is employed in cutting out and fixing together the edges of the rubber in making up these articles.

Rubber tubing.

Rubber tubing may be made in two different ways, according to requirements, *viz.*, (1) by wrapping calendered sheet round mandrils, covering lightly with French chalk and curing in live steam or, (2) in the form of seamless tubing by forcing the rubber compound, after mixing, through a special tubing machine, the "die" used corresponding to the diameter of tubing required. Rubber cord can be made in a tubing machine by removing the central die. The outside diameter of tubing depends on the diameter of the cylinder of the tubing machine through which the kneaded rubber is forced.

The compounded rubber is first warmed up and forced through the tubing machine by means of a screw. The tubing is run on to trays dusted over with French chalk or other powder and placed in the vulcanising pans.

Inner tubes are sometimes made in this way. Canvas hose is made in a similar way, using alternate layers of canvas and rubber.

Canvas hose is also made by wrapping alternate layers of calendered sheet and canvas on a mandril.

Rubber bands are cut from rubber tubing by means of special lathes. Washers are cut from calendered sheet which is rolled over a mandril to the desired thickness; they may also be stamped out of vulcanised calendered sheet.

Rubber tubing is removed from the mandrils on which it has been vulcanised by blowing air through under pressure, from small jets.

Motor and Cycle inner tubes.

Inner tubes are made by wrapping calendered sheet on a mandril and subsequent vulcanisation, in a manner similar to that described for tubing. The open ends, after cutting the tube to the desired length are solutioned together with pure para solution and vulcanised with sulphur chloride solution.

Inner tubes are sometimes moulded, the tube being inflated with ammonium carbonate or a mixture of sodium bicarbonate and tartaric acid to produce carbon dioxide gas.

Cycle and Motor tyres, etc.

The manufacture of tyres necessitates the use of special steel moulds of the shape and size of the tyre to be moulded.

This also applies to the manufacture of solid tyres for heavy motor vehicles, cabs, etc.

The moulds are usually made in two pieces—the inner and outer parts being screwed together and placed in the vulcanising pan or autoclave press. Much hand labour is required in the building up of pneumatic outer covers for cycles and especially so for motor tyres, where the cover is built up of alternate layers of rubber compound and proofed fabric. In some tyres, *e.g.* the Palmer motor tyre the machines for cording, etc., are very ingenious and complicated.

In the first place, the covers in the case of cycle tyres are made up in a circular flat form on circular steel bands and subsequently pressed to the desired shape.

It is impossible and unnecessary to give a more detailed account in this paper, since a great part of this important branch of the industry consists in the hand labour employed in building up the tyres or the special mechanical devices employed to save labour.

Waterproof Fabrics, Etc.

Proofed fabrics are used either as such for macintosh materials, etc., or as insertions in rubber hose, tyres, etc.

As stated under the general methods of preparation in the previous article the rubber compound is spread on the fabric from special friction calenders or on spreading machines; the principle being to spread a very thin layer of rubber on the fabric.

In the case of hot cured proofed fabrics, the fabric is spread with a thin layer of the compounded rubber containing sulphur, and the proofed fabric thus obtained is passed slowly through a special stove, at such a speed and temperature that it comes out satisfactorily cured.

In the cold curing process, a paste of the raw rubber is made in solvent naphtha and spread on the fabric on a special spreading machine; the "spread" fabric is then dipped in a sulphur chloride bath, or exposed to sulphur chloride vapours, or passed over rollers which dip in a sulphur chloride bath. All three processes are stated to be used.

The writer saw the last-named operation being carried on in one factory.

Cable Manufacture.

Cable manufacture forms a special branch of the industry, often carried on as the sole manufacture in works.

A cable consists of the following:— (1). Inner core or cable of copper, coated with tin, to prevent direct contact of copper and rubber which is deleterious to the latter. (2). Layer of pure raw rubber—consisting of Fine Hard Para—made from cut sheet, as described under that section. The cut sheet is cut into ribbons on a calendering machine and the ribbon wrapped round the inner wire core by means of special wrapping machines. (3). Layer of compounded rubber containing mineral ingredients without sulphur. (4). Outer layer consisting of compounded rubber containing sulphur. (5). Canvas layer. (6). Cover. The cable, after being built up as above, is vulcanised, only the outer layer containing sulphur becoming vulcanised; the inner layers of compounded and pure rubber free from sulphur serve to prevent any free sulphur from reaching the metal cable.

Ebonite or Vulcanite.

Since the methods employed in the manufacture of this material were not observed in any factory, no detailed description will be given here. The process of manufacture depends on the use of a large proportion of sulphur with rubber, the mixture being vulcanised for a long period and at a generally higher temperature than that employed for soft rubber goods.

Pencil and Ink Erasers.

In the manufacture of pencil erasers a soft rubber is made, which wears or crumbles when rubbed on paper, etc.; for ink erasion on the other hand some gritty material, *e.g.* powdered pumice, is mixed with the compounded rubber, as, in erasing ink marks, the paper itself is worn away by the rubbing.

Rubber Sponges.

The manufacture of these articles appears to be confined to one or two continental rubber firms in Europe. In the manufacture of mechanical and soft rubber goods, the difficulty appears to be to avoid holes due to air bubbles in the material. To obtain sufficient air-holes however to produce a rubber sponge appears to be even a more difficult problem.

Rubber Solution.

Rubber solution is usually made by treating the raw rubber in solvent naphtha; the rubber is churned up with the solvent in special machines constructed for the purpose.

Compounded rubber containing mineral and sulphur is also made up in a similar way for spreading purposes.

Reclaimed Rubber.

Patents for the reclaiming or regeneration of vulcanised rubber have been fairly frequent during recent years—although no remarkable progress appears to have been made.

Two methods for the utilisation of waste rubber may be adopted. (1). The grinding of the vulcanised waste and subsequent admixture with raw rubber minerals, sulphur, etc., in the mixing machines. (2). Preliminary treatment with some chemical with the idea of regenerating to some extent the properties of the raw material.

Waste rubber can be ground to a fairly fine powder in special machines, and the writer saw various grades and colours of this ground material being utilised in the manufacture of some of the lower and cheaper grades of rubber goods.

This material is obviously used as a "filler" for cheapening the article to be made.

The second method, which is known as "reclaiming" has recently assumed large proportions in America, where large reclaiming apparatus has been erected. Many of the processes used are naturally secret.

Sulphuric acid is used to destroy the fabric in some goods; alkali is also used to remove free sulphur and some patents claim that the rubber thus treated is devulcanised; this is probably not correct, although the rubber regains many of the properties of raw rubber and becomes capable of taking up more sulphur; the action may be one of depolymerization.

Conclusions.

The above is a brief outline of the methods adopted in the manufacture of the commoner and more important rubber articles of commerce. Except in details connected with the machinery, the processes used are substantially the same as they were shortly after the discovery of the process of vulcanisation by Goodyear and Hancock and the discovery of the process of cold vulcanisation by Mackintosh.

The field of rubber manufacture has, however, become greatly enlarged, as more uses have been found for the vulcanised material, and consumption of the raw material, for still other purposes, is likely to extend, with an increased output of the raw material and the consequent reduction in price.

The industry is undoubtedly becoming more scientific in its methods; there remains, however, much to be learnt in this interesting and new field of work, which now has almost assumed the position of a separate branch of chemistry known as colloidal chemistry.

The methods of testing and examination are physical as well as chemical and the processes involved in the coagulation of the latex in the preparation of raw rubber, as well as in the reaction between raw rubber and sulphur in the vulcanising process are probably of a dual physical and chemical nature.

ANALYSIS OF BOGA MEDELLOA OR TEPHROSIA CANDIDA.

The following is condensed from a report issued by Mr. M. Kelway Bamber, Govt. Agricultural Chemist, Ceylon, which he has authorised for publication. The report was received from Mr. R. W. Munro of Permatang Estate, Banting, Selangor, to whom thanks are due. Only such constituents as are known to be of direct influence as fertilizers are included in the condensed report.

The samples of leaves and stems were partly withered when received, so that the moisture in the growing plant could not be estimated. The figures given for the "Green Plant" are those calculated on the moisture found at the time of analysis, and as this was probably about 20% lower than it would be in the growing plant, the percentages given are higher in this proportion, than would be found in the plant when growing, or immediately after

cutting. The leaves and stems were analysed separately and gave the following figures :—

	LEAVES.		STEMS.	
	In Green Plant.	In Plant Dried at 100°C.	In Green Plant.	In Plant Dried at 100°C.
Moisture	54.53	...	14.06	...
Organic Matter ...	42.86	94.27	82.37	95.85
Ash	2.61	5.73	3.57	4.15
	100.00	100.00	100.00	100.00
Containing Nitrogen ...	2.03	4.47	1.71	1.99

Analysis of Ash.

	LEAVES.	STEMS.
Lime CaO	17.69	14.47
Magnesia MgO	4.61	4.67
Potash K_2O	21.47	32.89
Phosphoric Acid P_2O_5 ...	8.10	11.00
	100.37	100.29

Calculating the percentages found in the ash to the corresponding figures for the green plant and the dry plant, the following is the complete analysis :—

	LEAVES.		STEMS.	
	Green Plant.	Dried at 100°C.	Green Plant.	Dried at 100°C.
Moisture	54.53	...	14.06	...
Organic Matter ...	42.86	94.27	82.37	85. 95
Lime	0.46	1.01	0.51	0.60
Magnesia	0.12	0.26	0.17	0.19
Potash	0.56	1.23	1.17	1.36
Phosphoric Acid ...	0.21	0.46	0.39	0.46
	100.00	100.00	100.00	100.00
Containing Nitrogen ...	2.03	4.47	1.71	1.99

This shows that every 1000 lbs. of fresh green manure from this plant supplies the equivalent in Nitrogen, Phos. Acid and Potash, to about

400 lbs. Castor Cake
10 „ Bone Meal
10 „ Sulphate of Potash

and every 1000 lbs. of the prunings free from moisture are equivalent to about

900 lbs. Castor Cake
20 „ Bone Meal
25 „ Sulphate of Potash.

These figures compare very favourably with those published in the Royal Botanic Gardens circular from analyses of various green manures. The leaves are higher in Nitrogen than any except dadaps, which are given at 4.78% on the dry material, and if this plant gives as large a weight of green material per acre it will prove a very valuable green manure.

Two plants sown early in October 1909 cut at 2 ft. and weighed, gave 22½ lbs. which planted 6 ft. x 6 ft. = 13,590 lbs. per acre, in less than six months. One plant sown in 1907 which had been cut in 1908 and 1909 (July) was cut at 2 ft. 6 ins. and weighed 73 lbs., or, deducting wood, 50 lbs. Planted 8 ft. x 8ft. this equals 34,000 lbs. per acre, and this would represent about 300 to 340 lbs. of Nitrogen largely obtained from the air.

OPENING UP YOUNG RUBBER.

Basal V and Single Quarter System of Tapping.

By F. G. Spring.

The object of this experiment is to compare the Basal V system of tapping with that of the Single Quarter (Half herring bone) and to find out the relative amount of latex obtained from a varying number of cuts on the Single Quarter System. As the results for the first six months present some points of interest, they are published now as a preliminary note.

The experiment is being conducted at Kuala Lumpur Government Plantation, on land, where the slope, drainage, and nature of the soil is practically the same in each plot. The trees were not tapped previous to the commencement of the experiment. The number of trees in each plot is 100 and the average girth of the trees, measured three feet from the ground is practically the same; this, therefore should not account to any extent for the differences in yield of rubber.

The distance of planting is $12\frac{1}{2} \times 25$ ft. Fortunately no trees were lost by disease.

Comparing plots 1, 2, and 3, where the single quarter system is conducted, reference to the tables will show that in plot 1, where there is only one cut, the amount of total rubber is 68 lbs $3\frac{1}{2}$ oz, in plot 2, with two cuts, the amount of total rubber is 94 lbs $14\frac{1}{2}$ oz, while in plot 3, which has three cuts, the amount of total rubber is 66 lbs $9_{\frac{1}{2}}$ oz. It will be seen that two cuts, on the single quarter system, gives 28 lbs 5 oz more total rubber than three cuts, and considering that this difference is evident over a period of six months, the number of trees being 100, it would be expected that in one year the difference in favour of two cuts to a tree over three would amount to at least one half pound of rubber per tree per annum.

The tables also show that one cut actually gives more total rubber than three. The natural conclusion to be drawn is that three cuts on young trees, single quarter system, is too severe tapping. It will be interesting to see how large the difference becomes as tapping progresses.

The proportion of scrap and bark shavings in plot 1 (one cut) is comparatively low as compared with plot 3 (three cuts) while the amount of latex is comparatively high. With three cuts to a tree, the yield is low while the cost of labour is high but with two cuts the yield is high and the cost low. The writer is of opinion that in no case should there be more than two cuts to a tree on young rubber, no matter what the system may be. Comparing plot 4 (Basal V) with plot 2 (two cuts on the single quarter) it will be seen that there is an excess of 21 lbs total rubber in favour of the V and it would be expected that during the 2nd half year the difference would be still more in favour of this system.

Commencing with a top V 36 inches from the ground (see *Agricultural Bulletin of the Federated Malay States* Vol. 1. No. 9) and tapped for two years, or, until half the circumference of bark is removed a much larger amount of rubber is obtained than from 2 years tapping on the single quarter system. The writer is of opinion, however, that it is advisable to start on a basal V and not to commence a top V before the 3rd year.

Plot 1.

System of tapping—Quarter (Half Herring bone).
One cut 18 inches from the ground. Twenty cuts to the inch.
Every day tapping.
Average girth measured 3 feet from the ground 22. 59 ins.

Time of tapping	Latex rubber lbs.	oz.	Scrap rubbber lbs.	oz.	Bark shavings lbs.	oz.	No. of trees
15th Oct. to 14th Nov. 1912	13.	0	1.	9			
15th Nov. to 14th Dec. ,,	13.	6	1.	7			
15th Dec. to 14th Jan. 1913	12.	7	1.	7½			
15th Jan. to 14th Feb. ,,	5.	0	1.	14½			
15th Feb. to 14th Mar. ,,	4.	11	1.	11½			
15th Mar. to 14th April ,,	5.	13½	1.	13½			
Total ...	54.	5½	9.	15	3.	15	100

Plot 2.

System of tapping—Quarter (Half Herring bone).
Two cuts 18 inches apart. Twenty cuts to the inch.
Every day Tapping.
Average girth measured 3 feet from the ground 21. 75 ins.

Time of tapping	Latex rubber lbs.	oz.	Scrap rubber lbs.	oz.	Bark shavings lbs.	oz.	No. of trees
15th Oct. to 14th Nov. 1912	11.	2	1.	13½			
15th Nov. to 14th Dec. ,,	17.	0	1.	13			
15th Dec. to 14th Jan. 1913	13.	3	2.	3½			
15th Jan. to 14th Feb. ,,	10.	12½	2.	7			
15th Feb. to 14th Mar. ,,	9.	14	2.	4½			
15th Mar. to 14th April ,,	12.	6	3.	0			
Total ...	74.	5½	13.	9½	6.	15½	100

Plot 3.

System of tapping—Quarter (Half Herring bone).
Three cuts 18 inches apart. Twenty cuts to the inch.
Every day Tapping.
Average girth measured 3 feet from the ground 21. 29 ins.

Time of tapping	Latex rubber lbs.	oz.	Scrap rubber lbs.	oz.	Bark Shavings lbs.	oz.	No. of trees
15th Oct. to 14th Nov. 1912	7.	10½	1.	0½			
15th Nov. to 14th Dec. ,,	11.	14	1.	15½			
15th Dec. to 14th Jan. 1913	8.	12½	2.	12½			
15th Jan. to 14th Feb. ,,	5.	9½	2.	3½			
15th Feb. to 14th Mar. ,,	3.	6	1.	15½			
15th Mar. to 14th April ,,	10.	0½	2.	12½			
Total ...	47.	5	12.	12	6.	8½	100

Plot 4.

System of Tapping—Basal V.
One cut 18 inches from the ground. Twenty cuts to the inch.
Every day Tapping.
Average girth measured 3 feet from the ground 22. 28 ins.

Time of tapping	Latex rubber lbs.	oz.	Scrap rubber lbs.	oz.	Bark shavings lbs.	oz.	No. of trees
15th Oct. to 14th Nov. 1912	11.	9½	1.	4½			
15th Nov. to 14th Dec. ,,	16.	11	1.	10			
15th Dec. to 14th Jan. 1913	21.	1½	1.	6½			
15th Jan. to 14th Feb ,,	22.	0½	1.	12			
15th Feb. to 14th Mar. ,,	13.	2	2.	0½			
15th Mar. to 14th April ,,	16.	10½	1.	14			
Total ...	101.	3	9.	15½	4.	11½	100

No. of plot	Total Rubber lbs.	oz.	Latex Rubber lbs.	oz.	Scrap Rubber lbs.	oz.	Bark Shavings lbs.	oz.	Average girth 3 feet from the ground	No. of trees
1.	68.	3½	54.	5½	9.	15	3.	15	22. 59 ins	100
2.	94.	14½	74.	5½	13.	9½	6.	15½	21. 75 ,,	100
3.	66.	9½	47.	5	12.	12	6.	8½	21. 29 ,,	100
4.	115.	14	101.	3	9.	15½	4.	11½	22. 28 ,,	100

The results for the second half year will be published when the figures are available.

THE ECONOMICS OF PADI PLANTING.

By N. W. Barritt.

This article attempts to state the financial position of the raiat living his own life in a kampong and cultivating his two or three acres of bindang land, so as to show his prospects in terms comparable with those of the other industries which are supposed to be reacting adversely to his interests. The data upon which it is based have been arrived at after discussion with Penghulus and the raiats themselves, and consequently are liable to err only on the side of generosity in the valuation of the labour. The methods of cultivation are essentially the same throughout the States. Where differences occur they may be found almost in any one district, and are concerned with such details as the availability of implements and buffaloes ; but as these details are just those upon which the success of the cultivation depends they are of such importance as to warrant separate treatment. These differences are accounted for by dividing the methods of cultivation into three classes according to the nature of the land and the good fortune or otherwise of the natives to possess buffaloes.

Thus :—

(1) Tanah lembut or land consisting of soft clay to a depth of two or three feet.

(2) Tanah keras or land consisting of shallow stiff clay resting on a hard stubborn subsoil.

(*a*). Cultivated by ploughs.

(*b*). Cultivated by hand labour entirely.

(*1.*) *First class land.*

On this class of land ploughing is unnecessary and indeed impossible owing to its soft texture. The cultivation consists of cutting the weeds with a tajah or sharp hoe, and trampling them into the mud.

The cost of the cultivation and harvest works out as follows :—

		$	cts.
(i)	Preparation of nurseries and sowing 2 gantangs of seed per acre	1	20
(ii)	Cost of cutting weeds per acre. 2 men working 4 days @ 50 cts. per day	4	0
(iii)	Trampling weeds per acre. 1 man and 1 buffalo working 2 days @ $1-50 per day	3	0
(iv)	Transplanting per acre. 2 women working 10 days @ 50 cts. per day	10	0
(v)	Weeding per acre. 2 women working 3 days @ 50 cts. per day	3	0
(vi)	Harvesting (cutting twice) per acre. 5 women working 12 days @ 50 cts. per day	30	0
	Total cost per acre ...	51	20

Number of working days per acre per annum for a family of 3 = 40.

Average yield of padi per acre = 600 gantangs.

Value of padi at 10 cts. per gantang = $60.

(*2.*) *Second class land.*

This type of soil requires considerable cultivation to bring it into condition for transplanting the padi, and the returns at harvest are in proportion to the amount of tillage it receives. In addition to cutting the weeds ploughing, or its equivalent changkulling, harrowing and rolling are necessary to destroy the weeds and produce the right soil texture.

The cost of cultivation and harvesting works out as follows :—

(*a*). Using ploughs and buffaloes.

		$	cts.
(i)	Preparation of nursery and sowing 2 gantangs of seed per acre	1	20
(ii)	Cutting weeds per acre. (This operation is not always necessary.) 2 men working 4 days @ 50 cts. per day.	4	0
(iii)	Ploughing per acre. 2 men and 2 buffaloes working 5 days at $1-50 per day	15	0
(iv)	Harrowing per acre. 1 man and 1 buffalo working 3 days @ $1-50 per day	4	50
(v)	Rolling per acre. 1 man and 1 buffalo working 3 days @ $1-50 per day	4	50

		$	cts.
(vi)	Transplanting per acre.		
	2 women working 10 days @ 50 cts. per day	10	0
(vii)	Weeding per acre.		
	2 women working 3 days @ 50 cts. per day	3	0
(viii)	Harvesting per acre.		
	5 women working 10 days @ 50 cts. per day	30	0
	Total cost per acre ...	$71	20

Number of working days per acre per annum for 3 persons = 50

	(*b*). Cultivating by hand labour alone.	$	cts.
(i)	Same as in (*a*) (i)	1	20
(ii)	„ „ (ii)	4	0
(iii)	Changkulling per acre.		
	8 men working 10 days @ 50 cts. ...	40	0
(iv)	Trampling weeds per acre.		
	2 men working 3 days @ 50 cts. ...	3	0
(v)	Transplanting as in (a. vi)	10	0
(vi)	Weeding per acre „ (a. vii)	3	0
(vii)	Harvesting „ „ (a. viii)	30	0
	Total cost per acre ...	$91	20

Number of working days per acre per annum for 3 persons = 64 days.

Average yield on this class of land = 400 gantangs.

Value of padi at 10 cts. per gantang $40.

The above figures give one an idea of the cost of padi cultivation when undertaken by an outsider employing free labour, and also represent its position in competition with the plantation industry.

The profits of this cultivation vary from about $10 per acre on the best land to about minus $50 per acre on the poor land under unfavourable conditions. The most expensive item is the native method of harvesting by cutting each stalk separately, which averages about $30 per acre. This amounts to putting a premium on a custom which probably originated as a necessity in seasons of bad harvest but which now has chiefly a religious significance. With the standardisation of varieties and the introduction of the sickle this item could be reduced to about $6 per acre, and the profits of the best land would then be about $25 per acre.

Why should this product of the cultivation of the soil appear so profitless when compared with other cultivation such as Rubber and Coconuts? The reason is not far to see't. The high cost of living and the high price of labour follow each other in a vicious circle and have as yet scarcely affected the fictitious value of the commercial products of rubber and coconuts, but how fares it with the pro-

ducts of padi cultivation? Rice as a commercial product has shared in the rise of the cost of living but the value of padi, the raw material which should determine the value of the raiat's labour, has kept its former value, only fluctuating a few cents according to the skill of the miller in opening and closing his mills. Today the price of padi varies from 8 to 10 cents per gantang. It requires roughly 2 gantangs of padi to make one gantang of polished rice which is sold at prices varying from 30 to 50 cents per gantang, so that the miller increases the value of the rice from 50 to 150% in the process of milling! Obviously this is one of the absurdities of our modern commercialism.

If padi could realise its real value in the market of from 15 to 20 cents per gantang according to quality, the profits from padi cultivation would vary from an average of $50 per acre on the best land to about $30 per acre on the poorer land.

So far we have looked at padi cultivation from the point of view of an investment but the more correct view will be obtained by considering it in relation to the social and private life of the Malay native. For an expenditure of from 35 to 65 working days (of about 8 hrs.) for three persons according to the class of land a return of from 600 to 400 gantangs of padi is obtained, or sufficient of this staple article of diet to last 3 persons about 12 months. Thus a Malay family of 5 persons living on its 4 or 5 acres of bindang land obtains sufficient rice for the year with a surplus varying from 500 to 2,000 gantangs which can be sold at the rate of 8 to 10 cts. per gantang.

The writer has met with Malays in the Krian district who have obtained a harvest of 3,000 gantangs of padi, half of which they were able to sell for a sum of $135 in cash. If this surplus crop could realise its true market value today, would there be any other occupation that could offer the native such returns for a life lived after his own heart? With the introduction of improved methods of harvesting and a co-operative system of milling the padi locally, padi cultivation would be placed in such a position that it would compare favourably with any industry in the country.

BURR FORMATION: A PRELIMINARY NOTE.

By E. Bateson.

There are few rubber estates in the F.M.S. where trouble is not experienced with the excrescences known as burrs, and the subject, besides being of theoretical interest, is of great practical importance to planters. Much has been written on the formation

of burrs, but except for the discovery in Java that they can occur as the result of bark canker, nothing is known of the causes which give rise to them.

An observation made by the writer on an estate in Selangor may lead to some light being thrown on the subject. On this estate a large number of the trees were burred. The burrs were found on the untapped bark of trees about five years old, and were small spherical bodies, of the type to which the name "pea disease" is commonly given.

The point which attracted attention was their position. In previously published accounts no mention has been made of this, except for statements by some writers that it did not coincide with the position of the dormant buds, and it appears to have been taken for granted that they occur anywhere and everywhere on the bark. But on the trees in question they were found in every case a little below the slight depression which marks the position of an undeveloped bud. They were not always vertically below, but more often a little to one side. On a closer examination it was seen that they were invariably confined to the leaf-scars.

These are familiar to all planters as small brown marks, in shape roughly like a horseshoe, which are left on twigs when the leaves have fallen. On young green shoots they vary in size from three-sixteenths to three-eighths of an inch across, and are very conspicuous because of their colour. On older shoots they are much larger, and on the trunks of trees in tapping it is common to find them four inches across. The outline, however, is much less conspicuous. On smooth-barked trees they are usually visible even after some years of growth, but if the bark is rough often all traces of them are lost.

A search made in other parts of the F.M.S. has shown that a large percentage of burrs occur in the tissue under leaf-scars. Some hundreds of trees were examined in the Government plantations, Kuala Lumpur, and 74 burred trees were found. On 41 trees the burrs were near the base, where the bark was thick and the leaf-scars either obliterated or faintly marked, so that it was not possible to be certain as to the position of the burrs. On 26 trees the burrs occurred on leaf-scars. On the remaining 7 trees there were burrs on perfectly smooth bark some distance from the leaf-scars.

The occurrence of burrs on leaf-scars has also been recorded from Java by Dr. Rutgers, who was with me when I made the original observation.

The localisation of burrs to special areas of the cortex simplifies the problem of their origin. The old theory that a dormant bud was the cause cannot hold in cases where burrs occur on leaf-scars. They are some little distance from the bud, and it cannot therefore

give rise to them directly, and if it caused then by branching internally they would occur above the bud as well as below it. But in the cortex covered by the leaf-scar other bodies are present which may well be the cause of burrs, though they have not hitherto been suspected.

Like all other parts of the tree, the leaf is supplied with vascular tissue, which forms the veins in the leaf-blade. These join together and run down the leaf-stalk, and passing through the cortex of the stem connect on to the main system of conducting cells. The part in the cortex remains there when the leaf falls, and can be seen outside as a number of minute spots on the leaf-scar. Inside it is found as bundles running obliquely downwards through the cortex. As the stem increases in thickness these bundles lose their connection with the central vascular system, and are pushed towards the outside of the cortex. At the same time the circumference of the stem is increasing, and the cells are carried sideways in both directions, and become scattered in small fragments along the whole length of the leaf-scar.

The theory suggested is that these scattered cells give rise to burrs. They are functionless, and some of them, for example the cells of the phloem or bast, have contents which must sooner or later undergo decomposition, and the substances formed may easily be such as would set up irritation in the surrounding cortical cells. These would respond to the stimulus of irritation by dividing up to form a cambium, which would cut off cells around the offending body so as to isolate it. There would be nothing to stop the process of division once it was started, and in time a burr would be formed.

This method of origin is analagous to that discovered by Dr. Rutgers in trees affected by bark canker, where cells which appeared to be decomposing as a result of the disease were found to be surrounded by a cambium formed from the cortical cells, and this cambium gave rise to a reticulate, plate-like burr. Bark canker, of course, is not known in the F.M.S.

It is not supposed that all burrs found in the cortex of untapped trees originate in the way suggested above, in fact this method cannot account for the burrs found on parts of the bark other than the leaf-scars. The cause in these cases, however, though not isdentical, may be similar. For the formation of a burr it is probably only necessary that there should be some minute centre of irritation, and this might easily arise in other ways, for instance by local death of cortical cells, either from some pathological cause or as the result of injury. But the fact that the great majority of burrs on untapped bark occur on the leaf-scars plainly suggests that there is something in the underlying cortex which is responsible for their formation,

and the fragments of leaf-bundles which are always present in that position seem to be the most probable cause. The correctness of the theory remains to be proved, and the matter is now under investigation.

It should be mentioned that the theory does not attempt to account for the occurrence of burrs on tapped surfaces. In ordinary tapping the whole of the cortex is removed, and the remains of the leaf-bundles must be cut away at the same time. Some other cause must therefore be looked for to account for this type of burr.

REVIEW.

THE PHILIPINE COCONUT INDUSTRY, BY O. W. BARRETT CHIEF, DIVISION OF HORTICULTURE-BULLETIN 28 OF THE GOVERNMENT OF THE PHILIPPINE ISLANDS DEPARTMENT OF PUBLIC INSTRUCTION—BUREAU OF AGRICULTURE.

This Pamphlet No: 28 lately published by the Government of the Philippine Islands, Department of Public Instruction, Bureau of Agriculture, gives a very full exposition of the Coconut Industry carried on in the Philippines and although it particularly applies to that country, there is much general information about the culture which must prove both useful and instructive to, and may with advantage be followed by, those interested in coconuts in the Straits, Federated Malay States or elsewhere. The Author goes very thoroughly into the cultivation of the coconut from the plucking of the nut for seed until the time the tree has reached maturity. I quite agree with him as regards the care and attention to be given to the plant during the younger or earlier stages of its life, a matter of the greatest importance for the production afterwards of good bearing and healthy trees. I am not by any means in accord with the writer so far as his remarks refer to the coconut growing in proximity to the sea as the trees may be seen thriving exceedingly well in many of these localities. In asserting the fact that all wind movements must be detrimental more or less to the plant tissue, I can only say that if this really is seriously the case how is it that the coconuts near the sea on the East Coast of the Malay Peninsula, which have to contend against the full force of the North East Monsoon for several months of each year, produce excellent crops. Again I am still a firm believer in salt and my experience has been that salt mixed with cowdung in certain proportions brings on a young tree, situated in the inland plantations, very much faster than

would otherwise be the case and that the same manure used in larger quantities has also an excellent effect in maintaining good average crops on the matured trees. The estimates given for establishing coconut plantations of various acreages are also useful and generally the brochure is a most valuable addition to what has already been written on the subject and therefore should be in the possession of any one interested in the coconut industry.

L. C. B.

DEPARTMENTAL NOTES.

Mr. H. C. Pratt, Government Entomologist, Department of Agriculture, F.M.S., arrived at Kuala Lumpur, on return from leave and assumed his duties on June 4th.

Mr. A. G. G. Ellis, Asst. Agricultural Inspector, Department of Agriculture, F.M.S., arrived at Kuala Lumpur and assumed his duties on June 4th. (A. B. Vol. 1, No. 11, p. 413).

Mr. C. B. Holman-Hunt, Assistant Entomologist, Department of Agriculture, F.M.S., proceeded on leave on June 11th.

Mr. F. W. South, Chief Agricultural Inspector, Department of Agriculture, F.M.S., arrived at Kuala Lumpur and assumed his duties on June 13th. (A. B. Vol. 1, No. 10, p. 375).

SOIL ANALYSES.

Managers desiring analyses made of soils of their estates for the purpose of arranging manurial trials, etc., are requested not to take the samples themselves but to communicate with the Director of Agriculture, who will arrange that the officer in charge of soil work shall visit the estate, take the samples and make the necessary notes on conditions, etc., himself.

NOTES ON THE SINGAPORE MARKET FOR THE STRAITS PRODUCE DURING JUNE, 1913.

Black Pepper.—After an advance to $20\frac{1}{2}$ demand fell off, and the price gradually declined to $19\frac{3}{8}$ at which a small business was done to-day.

White Pepper.—Sarawak arrivals have begun to increase a little, and the crop, which will probably be from 10 to 15% below last year's, should be available in quantity during the next two or three weeks, The price has remained fairly steady throughout the month, and closes at $34 to $34\frac{3}{4}$ according to quality.

Gambier.—The improvement at the end of May was not maintained and the price declined once more to $6.85 at which there are still sellers.

Cube Gambier.—A moderate business was done in Hamburg Cubes at $10\frac{5}{8}$ to $10.40, the market closing easier at the lower quotation.

Copra.—With an excellent demand prices have rather firmed up and although demand is perhaps not quite so active as a week previously, values have been well maintained, and close at about the following for the principal grades dealt in::—

Bally	$12.20
Kayong	11.95
Pulo	11.85
Siantan	11.80

Rubber.—The market at the close is weak and prices have sagged considerably during the month. Closing quotations are—

Fine Pale Crêpe	$158
No. 2 Crêpe	140
Smoked Sheet	149
Unsmoked Sheet	140
Scrap Crêpe	120

Tapiocas.—Owing to the demand falling off prices are weaker, business having been done at $7 for Fine quality Small Pearl, $5.45 for Medium Pearl and $5.85 for Small Flake.

Nutmegs.—No supplies, prices nominally are $22.75 for 110's and $23.50 for 80's.

Sago Flour.—Has declined and business has been done as low as $3.37\frac{1}{2}/3.47\frac{1}{2}$ according to quality.

Singapore, 30th June, 1913.

FEDERATED MALAY STATES.

Comparative Statement of Cultivated Rubber Exported, with Value and Duty Collected Thereon, during the Years 1913 and 1912.

Places of Destination.	Exported during May, 1913.	Previously.	Total export during the year.	Export during similar period of previous year.	Increase.	Value of rubber, 1913, to date.	Duty collected, 1913, to date.
	Tons.	Tons.	Tons.	Tons.	Tons.	$	$
Straits Settlements ...	419.04	3,053.63	3,472.67	2,301.97	1,170.70	12,651,255	314,619.37
United Kingdom ...	692.61	3,529.17	4,221.78	2,964.77	1,257.01	13,890,658	347,268.95
Continent of Europe ...	75.24	452.51	527.75	398.94	128.81	1,753,573	43,839.33
Ceylon	38.81	216.40	255.21	171.97	83.24	851,404	21,285.10
Other Countries ...	...	...	...	...	...	...	...
Total ...	1,225.70	7,251.71	8,477.41	5,837.65	2,639.76	29,146,890	727,012.75

KUALA LUMPUR,
5th June, 1913.

W. J. P. HUME,
Commissioner, Trade and Customs, F.M.S.

Abstract of Meteorological Readings in the various Districts of Malaya for the Month of May, 1913.

DISTRICT.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	TEMPERATURE.				HYGROMETER.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Khota Bahru	...	147.	82.8	92.25	74.38	17.87	76.0	.772	71.5	.68	...	7.59	1.85
Malacca, Durian Daun Hos.	29.839	147.9	82.4	87.6	73.1	14.5	79.4	.961	...	.87	N. W.	7.87	2 28
N. Sembilan, Dist. Hospital Seremban	...	149.8	79.2	86.7	72.5	14.2	76.3	.852	74.3	.85	...	10 14	2.12
,, Dist. Hos. K. Pilah	...	159.6	81.1	90.5	72.8	17.7	77.5	.875	75.1	.82	...	4.32	0.72
,, ,, Tampin	...	157.3	80.5	87.1	73.6	13.5	76.2	.877	75.2	.84	...	8.80	2.45
,, ,, P. Dickson	...	154.5	82.3	87.8	75.0	12.8	77.8	.866	74.8	.78	...	5.44	1.55
Pahang, ,, K. Lipis	...	...	81.5	90.1	69.5	20.6	75.3	...	...	...	...	13.43	3.30
Penang, ,, Penang	29.808	153.	82.7	95.	72.	23.	78.3	.874	75.1	82.3	...	16.14	3.64
Perak, ,, Taiping	...	105.	82.4	92.	72.	20.	77.85	.898	...	.83	...	14.13	2.19
,, ,, Ipoh	...	...	81.76	92.	70.	22.	77.23	.874	...	.81	...	9.40	1.97
,, ,, T. Anson	...	...	81.87	92.	69.	23.	78.34	.922	...	.85	...	11.96	1.95
,, ,, P. Buntar	...	...	81.72	90.	73.	17.	77.76	.899	...	.85	...	11.46	4.52
,, The Cottage	...	...	...	...	...	...	...	...	...	...	...	35.18	4.95
Selangor, General Hospital Kuala Lumpur	...	145.3	81.9	88.8	72.	16.	77.6	.880	75.3	.83	...	8.10	2.52
,, Dist. Hos. Klang	...	...	...	87.5	71.1	16.4	...	...	...	...	...	4.88	0.95
,, ,, K. Selangor	...	...	...	88.7	69.5	19.2	...	...	...	...	...	1.91	0.81
,, ,, Rawang	...	...	...	90.2	72.4	17.8	...	...	...	...	...	11.02	2.27
Singapore, Kandang Kerbau Observatory	29.870	155.5	83.5	92.4	73.8	18.6	78.6	.907	...	.80	S. E.	7.85	3.28